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SPECIFIC CONLITIONS FOR THE PROFITABLE PROCESSING
OF OIL SHALE AT RUDA NEAR SINJ IN YUGOSLAVIA

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Every type of oil shale is suitable for processing, provided it contains a sufficient concentration of kerogen, and particularly if the shale yields sufficient tar when subjected to dry distillation. For further, more detailed evaluation of the profitability of such processing, market conditions and outlook should be considered first. If these are favorable, then special attention must be given to the extent of the investment, the possibilities of establishing high amortization and interest rates, and a detailed analysis of investment and exploitation possibilities and requirements.

Very few countries process oil shale just for the tar. In view of the relatively low price of crude petroleum, the processing costs of which are considerably lower than those for processing tar from oil shale, it is obvious that tar production is more or less dependent on subsidies.

When and under what conditions could the oil shale industry become profitable and compete successfully with the petroleum industry? It should be kept in mind that, compared with petroleum, oil is not particularly valuable unless it contains sufficient paraffin, the most valuable component of oil.

The dry distillation of oil shale yields gases, distilled water, tar, and low temperature coke. The gases represent potential thermal power; they are especially valuable if they are rich enough in hydrogen sulfide and ammonia to warrant financing and building installations to extract these substances together with ammonium sulfate, elemental sulfur, and distilled water. After the extraction of these substances, the purified gases can be utilized profitably for heating, or as fuel for internal combustion engines producing electric power, and gas for turbines.

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By customary methods tar is processed by first separating the acid and basic components and processing and refining each one. Little lubricating oil or coal tar can be obtained from this tar; at best, inferior quality winter motor oil is obtained. Assuming that there is little or no asphalt, the most valuable components are hard and soft paraffins. The processing of the individual components with acids and alkalis, and by filtering through various absorbents involves many separate operations, and requires many intermediate processes and space for them. All in all, the entire refining process is more expensive than petroleum processing, the losses are much greater, and the finished products poorer in quality.

New processing methods include cracking of individual components or groups of them, and finally combining this process with other processes, such as catalytic processes. The total number of operations here is still proportionately large, but the final results are better. The most promising are the new hydrogenation methods, where the losses are relatively small and the finished products are very stable [pure?], requiring only limited refining, if any. Hydrogenation is undoubtedly the best method although it puts the most strain on equipment and requires large investments.

Low-temperature coke should first of all contain sufficient organically bound carbon, for enough heat can be developed from the combustion of this carbon to take care of the entire process, so there is no need to use the distilled gas for this purpose. In addition to this carbon, low-temperature coke always has an inorganic component. This may be either a useful substance or a waste. For instance, if the inorganic component is limestone, the residue after burning can be utilized as quicklime. Technical literature shows that Swedish oil shales, for instance, contain uranium; after the tar is extracted, the inorganic residue may be utilized for the same purposes as uranium ore. Some efforts have been made to utilize the inorganic residues of oil shale as hydraulic binders, which makes them even more valuable.

In low-temperature distillation, especially of shale whose residue can be utilized as an hydraulic binder, it is possible to simplify the processing and reduce the cost. The ideal case is that in which the inorganic component cement marl contains enough organically bound carbon to obtain a temperature which will convert the whole into finished clinker. In such cases, low-temperature distillation should be combined with the clinker-yielding process into a single process, thus greatly reducing the work connected with oil shale processing, decreasing production costs, and increasing the possibility of profits.

The oil shale at Ruda near Sinj is almost ideal. The percentage of tar averages about 13 percent for deposits 6 to 7 meters thick. The inorganic component is almost ideal. It needs very little clay to improve its hydraulic coefficient to make it good cement. The low-temperature coke contains sufficient carbon to develop 1,000 to 1,200 calories per kilogram of clinker. The processing, however, is not as simple as the processing of natural cement marl, for the raw material must be first homogenized by powdering and modification, but this must also be done in the wet method of cement manufacture and so does not entail special expenditures.

The wet-processing method in the cement industry is profitable even when fuel has to be supplied. When the fuel is found in the raw material itself, profitability increases since profits in the cement industry depend mostly on fuel costs, especially on the cost of fuel transport. Oil shale low-temperature coke is therefore excellent since it furnishes free fuel.

Since coke can be obtained from this oil shale, the inorganic component is adequate, and the organically bound carbon content in the low-temperature coke is adequate, the sole problem is the construction of an installation for low-temperature distillation, which makes it possible to lift raw material to the

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hopper, whence it reaches the furnace by gravity, leaving it finally in the form of clinker. The organic part (the kerogen would decompose into organically bound carbon and gas) is the distillate, consisting of gases (inflammable and noninflammable) and tar vapors. The tar vapors are condensed into tar fog and separated from other gases, which are exploited further. In the case of the oil shale in Ruda, quicklime production is a good solution for the utilization of such gases. There is plenty of limestone in the vicinity, but there is a scarcity of lime, which is a normal result of a shortage of fuel. There are, however, some other possibilities, such as the calcining of gypsum, for there is plenty of first-class gypsum whose export possibilities are good.

In addition to clay being added to oil shale to provide the necessary natural hydraulic coefficient, clay serves well as a binding material in briquette production, or in the modification of oil shale powder so that the mass becomes plastic, an effect produced by what may be regarded as a mineral grease. The addition of clay increases the total quantity of clinker but does not lower any of the installation's distillation capacity. The carbon combustion process may even be intensified if some powdered lignite is added to the oil shale powder before briquetting. In its raw state lignite contains not more than 10 percent ash and 35 to 40 percent low-temperature coke. In addition, during low-temperature distillation lignite becomes very porous, thereby allowing free circulation of air, so that air can circulate through each briquette in the same way. As more of the organically bound carbon of the lignite is burned out, the air channels become larger and deeper intensifying combustion and promoting the distillation process. The crumbling of the lignite is not difficult and does not put any significant load on the operation.

The Ruda area has favorable conditions for the extensive and diverse exploitation of clay, lignite, and gypsum. There is a surface vein of lignite near the village of Svinjaca, gypsum at Glavica, and very good clay at Labrovic.

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